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Monograph of *Iacra* (Bivalvia: Semelidae)

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Abstract. The alpha-taxonomy of the semelid subgenus *Iacra* reveals that there are three living species of this taxon of bivalves: *seychellarum*, *petiti*, and *trotteriana*, all with principal centers of distribution in the Western Indian Ocean. Primary type-material for all species-level nomina was reviewed; lectotypes were chosen for *Scrobicularia seychellarum* and *Iacra petiti* Dautzenberg; and a neotype for *Strigillina lactea* Dunker was designated. *Iacra* is of interest because of its acentric, scissulate sculpture which converges with that of the tellinid *Strigilla*.

INTRODUCTION

Iacra constitutes a little known group of bivalves which belong to the tellinacean family Semelidae and which, though one species ranges into the tropical western Pacific, is principally distributed in the Western Indian Ocean. Conventionally, the taxon which was introduced by H. and A. Adams (1856), is considered a subgenus of the cosmopolitan, highly eurytopic genus *Abra* (Dall, 1900; Thiele, 1935; Keen, 1969).

Phenomenally interesting is the convergent resemblance which *Iacra* bears to the tellinid *Strigilla*. Both *Iacra* and *Strigilla* are similarly shaped, being more or less roundly ovate or circular in outline, and both exhibit the so-called acentric scissulate sculpture (Boss, 1966). Superficially the shells of the two genera are so similar externally that only the morphology of the hingement can differentiate them. *Iacra* has the typical semelid hinge which bears an internal ligament or resilium in a subtending supportive chondrophore; tellinids lack this structure. The two genera are

more or less allopatric: *Strigilla* is represented by a couple of poorly known species in the Australian and West African regions and has its central radiation in Western Tethys, embracing the Caribbean and Eastern Pacific regions. *Iacra* is found mainly along the coast of East Africa, around Madagascar and in the Red Sea.

Sculpture in the bivalves is usually formed concentrically as the shell grows periodically around its entire mantle edge or radially as structural differentiations in the shell form at discrete positions along the edge of the mantle. In the case of acentric sculpture, the peripheral mantle secretory areas shift positions during growth and form the sculpture discordantly. Such unusual sculpture has arisen several times among lineages in the superfamily Tellinacea (Boss, 1966) and occurs in several other families of bivalves as well (Seilacher, 1972). Among tellinids, the suborbicular shape and bilaterally acentric sculpture is typical of *Strigilla* (Boss, 1969) while within the confines of the family Semelidae, it is limited to *Iacra*. As illustrated in Plate 20, figs. 1-3, the acentric incised scissulations cover the surface of the disc of the shell and descend ventrally at an angle of about 45°. Along the posterior dorsal slope the sculpture is angled upward and the lirations are compressed closer together while along the anterior dorsal slope, simple concentric sculpture is evident as is the marked zone where discordance commences (Plate 20, fig. 4). In *Iacra* as well as in *Strigilla*, the exact nature of these differential sculptures combine with features of the pallial sinus, dentition and size of the shell to form taxobases which distinguish species.

The functional and adaptive significance of discordant sculpture in *Strigilla* has been discussed by Stanley (1969: 1970). By inference, this unusual sculpture probably serves the same functional role in *Iacra*. *Strigilla carnaria* and *S. mirabilis* from Puerto Rico are very rapid burrowers. They position themselves vertically with an active and extensible foot and commence penetration of the substrate with a rocking movement during which the scissulations dig into and displace the sand. The acentric sculpture, thus, acts as an important mechanical aid in the penetration

of, and slipping through, the substrate. *Strigilla* normally lives in clear sandy substrates where current or wave action frequently necessitates reburial or at least downward movement for maintenance of normal burrow depths (Stanley, 1969). The animals are rather deep burrowers and live in depths of the sediment several times their own shell lengths. The position taken up in the sediment is various but always with the posterior end uppermost and at least the incurrent siphon extending toward the substrate interface. Presumably *Strigilla* is a suspension or interstitial feeder since deposit feeding was not observed in either *S. carnaria* or *S. mirabilis* (Stanley, 1970). It is also probable that the grain of the acentric sculpture serves to maintain position in the substrate as well as to anchor the shell when the siphons are retracted (Boss, 1966). Although little information is available on the ecological preferences of the three species of *Iacra*, most of the data point to their preferring sandy substrates in subtidal depths, and utilizing their sculptural peculiarities in much the same way as *Strigilla*.

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ABBREVIATIONS

ANSP — Academy of Natural Science, Philadelphia
BMNH — British Museum (Natural History), London
DMNH — Delaware Museum of Natural History, Greenville
IRSNB — Institut Royal des Sciences Naturelle de Belgique
MCZ — Museum of Comparative Zoology
MNHNP — Muséum National d'Histoire Naturelle, Paris

NMW — Naturhistorisches Museum, Wien

NR — Naturhistoriska Riksmuseet, Stockholm

NSMT — National Science Museum, Tokyo

SAM — South African Museum, Cape Town

USNM — National Museum of Natural History, Washington

ZMB — Zoologisches Museum der Humboldt-Universität, Berlin

SYSTEMATIC SECTION

SUBGENERIC SYNONYMY

Iacra H. and A. Adams 1856, Gen. Rec. Moll. 2: 409 (type-species, by monotypy, *Scrobicularia seychellarum* A. Adams, 1856).

Strigillina Dunker 1861, Malak. Blätt. 8: 43 (type-species, by monotypy, *Strigillina lactea* Dunker, 1861).

Jacra Dunker 1882, Nov. Conch. Suppl. 7: 194, error *pro* *Iacra* H. and A. Adams 1856.

Remarks. *Iacra* is differentiated from all other semelids by its elaboration of acentric scissulate sculpture very similar to that found in the tellinid *Strigilla*. The presence of an internal ligamental element which is supported by a variously shaped chondrophore allocates *Iacra* to the Semelidae (Boss, 1972). As Keen (1969) has pointed out, *Iacra* is placed in the genus *Abra* which consists of species whose shells tend to be thinner and smaller than *Semele*. More importantly, the pallial sinus of *Abra* and its constituent *Iacra* are confluent with the pallial line while in *Semele* the pallial sinus ascends obliquely from the pallial line at its most posteriad.

Iacra consists of three species: *seychellarum* with strongly developed internal chondrophore, narrowly set, incised scissulations, whitish coloration and wide tropical western Pacific and Indian Ocean distribution; *petiti* also with strongly developed internal chondrophore, rather widely set, incised scissulations, mostly yellowish-purplish coloration and a distribution restricted to Madagascar and the

adjacent coasts of southern Africa; and, *trotteriana* with a weakly developed, obscure internal chondrophore, variously set and developed sculpture, whitish coloration and poorly known distribution in the Western Indian Ocean including the Red Sea, South Africa and Madagascar.

Abra (Iacra) seychellarum (A. Adams)

Plate 20, figs. 1-4; Plate 21, figs. 1-3

Plate 22, figs. 1-4; Plate 23, figs. 1-2

Map 1

Scrobicularia seychellarum A. Adams 1856, Proc. Zool. Soc. London 24: 53 (lectotype, here selected, BMNH 78.1.28.197; type-locality, Seychelles [Seychelle Islands]).

Scrobicularia (Iacra) seychellarum (A. Adams). H. and A. Adams 1856 (Nov.) Gen. Rec. Moll. 2: 409.

Strigillina lactea Dunker 1861, Malak. Blätt. 8: 43-4 (neotype, here selected, MCZ 288004; type-locality, aus dem Rothen Meere).

Iacra japonica A. Adams 1864, Ann. Mag. Nat. Hist., (3), 13: 307-315 (holotype, lost, not located in the BMNH, pers. comm. Ms. K. Way; type-locality, Kino-O-Sima [Japan]).

Syndosmya strigilloides Vaillant 1865, Jour. de Conch. 13: 125, pl. 6, fig. 1 (holotype, MNHNP; type-locality, sur la plage du désert de l'Attaka, Baie de Suez).

Iacra vaillanti 'Jousseume' Sowerby and Fulton, 1903, Recent Mollusca. A catalogue of Pelecypoda and Brachiopoda, p. 22, *nomen nudum*.

Description. Shell extending to 20 mm in length, 18 mm in height, and 9.0 mm in width, rounded-subtrigonal in outline, slightly inequilateral with posterior portion somewhat greater in length than anterior, moderately inflated with right valve slightly more convex and with slight flexure to left posteriorly. Umbos subcentral, slightly anterior, a little elevated above the hinge line, pointed and weakly opisthogyrous. Anterior margin broadly rounded, distinctly separated from anterior dorsal margin in right valve; ventral margin weakly convex to almost straight; posterior margin broadly subtrigonal, forming weakly pointed posterior outline; anterior dorsal slope short, slightly convex; posterior dorsal margin longer, more or less straight and rather steeply inclined.

Sculpture consisting of three moieties: anteriorly concentric, finely incised lirations (2-6/mm) and more closely

crowded along anterior dorsal slope; scissulate lirations over the postero-central portions of disc (2-6/mm) and extremely closely-spaced, finely incised lirations along posterior dorsal slope (8-16/mm). Posterior ridge weakly developed, especially in left valve. Putative growth annulae from 1 to 7, indicated by differential translucence of shell substance.

Ligament opisthodontic, consisting of very short, external, mostly periostracal element in elongate-lanceolate, weakly distinct escutcheon, an internal variously developed, but usually rather strong, elastic, calcareous portion, resting in spatulate chondrophore.

Hinge line consisting of both cardinal and lateral dentition. Dentition stronger in right valve, cardinal complex consisting of short, protuberant, narrowly subdeltoid anterior and posterior teeth; right anterior lateral tooth subproximal to cardinal complex, shelf-like, bluntly pointed and socketed above; right posterior lateral tooth distal, posterior to external ligament and chondrophore, elongate, narrowly shelf-like, bluntly pointed and socketed above. In left valve, cardinal complex consisting of narrowly to strongly subtrigonal anterior cardinal tooth and thin, obsolete, frequently absent posterior cardinal tooth, often consisting of nothing more than a wrinkle along the ventral edge of the internal ligament. Anterior lateral tooth subproximal to cardinal complex, very weak, consisting of irregularly pointed or knob-like protuberance; posterior lateral tooth even weaker, distal, behind the posterior to ligamental plate, and consisting of pointed, shelf-like protuberance.

Muscle scars not strongly impressed. Anterior adductor muscle narrowed and more elongate than rather rounded posterior adductor. Pallial sinus unequal in opposite valves. In right valve, pallial sinus not contiguous with anterior adductor muscle, gently descending anteriorly from posterior adductor muscle to form confluence with pallial line along ventral margin. In left valve, pallial sinus arising slightly from posterior anterior muscle to form gentle arch and subsinuately descending anteriorly to confluence with pallial line at or very near anterior adductor muscle.

Shell white, opalescent, very rarely with whitish-gray, vague, mostly central suffusions; internally frequently highly polished.

Measurements:

Length	Height	Width	H/L	W/L	Remarks
21.5 mm	17.2 mm	mm	.80		lectotype of <i>seychellarum</i> left valve
16.0	13.0	6.0	.81	.37	holotype of <i>strigilloides</i>
14.2	12.0	6.3	.84	.44	neotype of <i>lactea</i>
18.4	15.7	8.4	.85	.46	Red Sea
17.6	14.3	5.9	.81	.34	Mahé, Seychelle Is.
17.0	14.1	7.8	.83	.45	Ceylon
16.9	14.9	8.3	.88	.49	Red Sea
15.3	12.4	5.2	.81	.34	Aden
13.5	10.8	5.7	.80	.42	Mahé, Seychelle Is.
12.3	11.3		.91		Thursday Is.
10.5	9.2	4.9	.88	.46	Mahé, Seychelle Is.
9.4	8.4	5.0	.90	.53	Ugui, Shingu City, Japan
8.9	6.5	3.5	.73	.39	Luzon
8.8	6.2	3.4	.70	.38	Ceylon
6.8	5.4	3.1	.79	.45	Madras, India
6.5	4.8	2.5	.74	.38	NW Bay, Mahé, Seychelle Is.
5.5	4.8		.87		Bien Son, Vietnam

Types. Adams (1856) described *Scrobicularia seychellarum* on specimens obtained by a Mr. Ricketts and, at that time, belonging to the Cuming Museum. I have chosen a lectotype from a plaque in the BMNH which is marked "M.C." but which does not bear the name of Ricketts. The lectotype (Plate 20, fig. 3; Plate 22, fig. 3) consists of one broken right valve and one complete left valve measuring 21.5 mm in length and 17.2 mm in height and bears the catalog number 78.1.28.197. This is the first illustration of the type-specimen, the only previous figure of a specimen referred to as '*seychellarum*' being that of Boshoff (1965, p. 183, pl. 9, fig. 2) from Punta Torres, Inhaca, Mozambique. The back of the plaque in the BMNH bears the contradictory notation: "smallest from the Colln of H. Adams 78.1.28.197". The other two remaining specimens on the plaque are also *seychellarum*, one consisting of one complete pair, probably that of Preston from Ceylon, the other of an imperfect set comprized, like the type, of a broken

right valve and a complete left valve; this latter specimen is probably the one cited by McAndrew (1870) from Suez in the Red Sea.

Since Dunker (1861: 44) specifically states that the specimens upon which he based his description were in the collection of H. Dohrn in Stettin and since that collection was destroyed in World War II (Dance, 1966: 285), I have selected a neotype (MCZ 288004) (Plate 21, figs. 1 and 2) which was originally in the Dohrn collection and which bears an old hand-written label stating "*Strigillina* [Dkr.] n. genus near *Semele* [*lactea* Dkr.] Red Sea". The neotype measures 14.2 mm in length and 12.0 mm in height; the original holotype was 16 mm long. Type-material of this specific nomen has never been illustrated and the first and only illustration of specimens referred to *lactea* was by Odhner (1919, p. 28, pl. 2, figs. 20 and 21), a sample dredged from Tamatave, Madagascar and preserved in the Kaudern Collection of the Rijksmuseum in Stockholm.

Type-material of *Iacra japonica* A. Adams could not be located in the BMNH (Ms. K. Way, *pers. comm.*); an illustration bearing this specific epithet has only been published once (Habe, 1952: 209, figs. 503-4). The original type-locality, Kino-O-Sima is surely problematic and can not be pin-pointed. Consultation with a gazetteer of Japan (U.S. Board on Geographic Names) shows that there are at least 12 islands of the name Okino-Shima, including one in the Oki Guntō (Oki Archipelago) on the west coast of Japan in the Japan Sea at 36°N; 133°E. The original specimens of *I. japonica* probably came from somewhere along the Pacific Coast of Japan as the known Oriental population of *seychellarum* (= *japonica*) extends along that coast and the southern islands from 23° to 34°N (Kuroda and Habe, 1952: 12).

The holotype of *strigilloides* (Plate 20, figs. 1 and 2; Plate 22, figs. 1 and 4) in the MNHNP measures 16 x 13 x 6 mm and was figured in the original description (Vaillant 1865: pl. 6, fig. 1; the type locality was given as 'sur la plage du désert de l'Attaka'; the label with the holotype specimen does not bear this specific locality but reads 'Baie de Suez'. After a thorough search of several gazetteers,

including the French Colonial Atlas, I was unable to locate any place called Attaka in the Suez area.

Shortly following Vaillant's description, Semper (1866: 166) pointed out that *strigilloides* was a synonym of *Strigilina lactea* Dunker 1861. In his original description of *strigilloides*, Vaillant noted that the species, here referred to the semelid genus *Abra*, resembled the genus *Strigilla* of the Tellinidae in the unusual superficial sculpture on the surface of the shell.

Anthony (1905) cited '*Syndesmya strigilloides*' from the Gulf of Tajura, near Djubiti, in the Gulf of Aden though the specimen bearing this locality in MNHNP is *trotteriana*. Lamy (1913: 296-7) placed *strigilloides* in the synonymy of *Syndesmya (Iacra) lactea* Dunker and noted that the type was in the Collection of the Museum in Paris.

Iacra vaillanti is a *nomen nudum*, having never been described by either Jousseau, Sowerby or Fulton; specimens labelled *vaillanti* were sent by Sowerby to Lamy (1913: 297) who recognized that they were *lactea* [= *seychellarum*].

Remarks. Of the three species which constitute *Iacra*, *seychellarum* is surely the best known and most widely distributed. From *trotteriana*, it may be distinguished by its large conspicuous chondrophore while from *petiti*, to which it is more closely allied, it can be differentiated by its finer sculpture (2-6 scissulations per mm), more subtrigonal shape, more fragile, thinner valves, generally white coloration, and pallial sinus, which in the left valve is contiguous with the anterior adductor muscle. Additionally, *seychellarum* is almost always more laterally compressed than *petiti* (W/L mean = .42).

The range of *seychellarum* overlaps that of *trotteriana* along the coast of East Africa, in the Red Sea and possibly in Madagascar. *Iacra petiti* probably does not co-exist with *seychellarum* although there are some geographic records from Madagascar which might so indicate, but there are too few samples known to have been obtained from living populations.

Iacra seychellarum is less variable than *trotteriana* in shell features. Usually it is relatively thinly shelled and its sculpture tends to consist of rather evenly spaced, finely

incised scissulations which number about 2-6 per mm. The species is apparently rather rare in the eastern portion of its range and smaller in size than in the western Indian Ocean (see measurements and compare Plate 23, figs. 1 and 2). The few samples from Japan, Vietnam, the Philippines, the East Indies, the Torres Straits and the subcontinent of India indicate its rarity and consist of smallish individuals with noticeable subtrigonal and rather pointed posterior outlines. Very occasionally specimens will lack the union of the pallial sinus and the anterior adductor muscle scar in the left valve; in these few individuals the sinus becomes confluent with the pallial line just ventral to the anterior adductor.

Evidently the species prefers relatively shallow water and a sandy substrate (Taylor, 1968), and though there are no real data to substantiate the generalization, it appears that *seychellarum* lives in large populations where the ecological conditions are optimal—namely the warm tropical waters of the outlying islands of east Africa.

In immature specimens, at size ranges below 5 mm in length, the outline of the valves is distinctly tellinoid being more subquadrate-elongate than in adults. Shells at 2-3 mm in length are extremely fragile, have a distinct and strong internal resilium resting in a pendant chondrophore. Acentric scissulate sculpture is already apparent, especially in the right valve, in very young individuals even only 3 mm long, it consists at this stage of 4 or 5 angled, incised lines along the posterior portion of the disc. Such sculpture begins just after the smooth tiny prodissoconch, at shell lengths of 1.5-2 mm.

In a very few individuals, especially smaller ones, the pallial sinus of the left valve is not wholly contiguous with the anterior adductor muscle but is confluent with the pallial line just ventral to the adductor scar. The shells, however, are recognizable as *seychellarum* by their lateral compression, fine sculpture, and subtrigonally pointed posterior outline.

From collection data it is apparent that the species prefers clean, white sand as its substrate; living animals have been procured in from 1-8 fathoms of water although McAndrew

(1870) and Cooke (1886) cited a range from 10–20 fathoms.

The record of *Strigilla carnaria* Linnaeus from Mauritius provided by Viader (1937) may well refer to *I. seychellarum*.

Published records for the distribution and occurrence of *I. seychellarum* (and its synonyms) include: entrance to Suez Canal, Egypt ("sur la plage de Moya Soukh", Moazzo, 1939); Hammam Faraoun, Egypt (Lamy, 1938); Bay of Suez (Vaillant, 1865; Semper, 1866; Issel, 1869; McAndrew, 1870; Cooke, 1886); Red Sea (Dunker, 1861; Paetel, 1892; Sturany, 1901); Aden (Smith, 1891; Anthony, 1905); Seychelle Islands (Adams, 1856; Adams and Adams, 1856); Madagascar (Odhner, 1919; Dautzenberg, 1929; 1932); South East Asia [Annam=Vietnam] (Dautzenberg and Fischer, 1906); Taiwan (Kuroda, 1941; Skarlato, 1965); Japan from 23°–34°N (Adams, 1864; Dunker, 1882; Habe, 1952; Kuroda and Habe, 1952).

Specimens examined (Map 1). MOZAMBIQUE: Delagoa Bay (SAM). MADAGASCAR: plage de Tuléar; baie de Ranofotsy, SW of Fort Dauphin; baie de Galions, W of Fort Dauphin; plage de Vatomandry; plage d'Andevoranto, N of Vatomandry (all IRSNB); Tamatave (NR); Nosy Bé (SAM); 2 mi SE of Nosy Iranja, 32 mi SW of Nosy Bé, 8 fms sand (DMNH; ANSP); Nosy Iranja, 10–12 m (MCZ); 6–20 ft, clear white sand, between Ambatoloaka and Madirokely, SW of Nosy Bé (ANSP); 0–8 ft, sand, grass, coral, rock between Ambatoloaka and Madirokely, SW Nosy Bé (ANSP). TANZANIA: Mbos Mogi, 9 mi S of Dar-es Salaam (USNM). SEYCHELLE ISLANDS: Seychelles (USNM; IRSNB); Mahé (BMNH); NW Bay, Mahé (BMNH); Port Ternay, NW Mahé (MCZ); 15–40 ft, sand and grass, Port Ternay, NW Mahé (ANSP). ADEN: (BMNH; IRSNB; MNHNP; NMW; USNM; ZMB); Khor Maksar Beach, Aden (BMNH). EGYPT: Pola Station 5, Rás Mallap, 29°12'N; 32°55'E, off Sinai Peninsula, Gulf of Suez (NMW); Suez; Baie de Suez (both MNHNP); Red Sea (IRSNB; MCZ; MNHNP; ZMB). INDIA: Sindi, presidency of Bombay, between Cutch and Beloochistan; Madras (both BMNH). CEYLON: Ceylon (BMNH). INDONESIA: Pelaboen Ratoe, [=Palabuhan Ratu], 7°05'S; 106°27'E, Java (USNM). VIETNAM: Bien Son, N of Vinh, Gulf of Tonkin (IRSNB).

PHILIPPINE ISLANDS: Luzon (IRSNB). AUSTRALIA: Thursday Island, 10°35'S; 142°13'E, 30 mi N of Cape York, Torres Strait, N. Queensland (BMNH). JAPAN: Ugui, Shingu-City (33°39'N; 135°58'E), Wakayama Pref., Honshu (NSMT).

***Abra (Iacra) petiti* (Dautzenberg)**

Plate 24, figs. 1-4; Map 2

Iacra petiti Dautzenberg 1923, Jour. de Conch. 68: 72-74, 3 figs. (lectotype, here selected, IRSNB; type-locality, here selected, plage d'Ankilibé (23°25'S; 43°45'E), Madagascar).

Description. Shell extending to 14 mm in length and to 13 mm in height, subovoid, slightly inequilateral, subequivalve with left valve slightly larger, more inflated and convex, solid, rather plump and inflated with barely detectable posterior flexure to right. Umbos slightly anterior to the middle, pointed, nearly orthogyrous, flattened, and left umbo a little lower than right. Anterior margin broadly rounded and gently convex; ventral margin broadly convex; anterior dorsal margin short, gently inclined, more or less straight and tending to abrupt confluence with anterior margin; posterior dorsal margin longer, steeply inclined and more or less straight; posterior margin short and weakly convex.

Sculpture consisting of three moieties: anterior slightly acentric, incised, rather widely spaced lirations (2-4/mm) more crowded along dorsal slope; acentric, posteriorly descending scissulations on central disc (2-4/mm); and, very closely spaced, finely incised lirations along the posterior dorsal slope (7-10/mm). Posterior ridge not strongly developed especially reduced in left valve. Possible growth annulae (up to 7) noted by differential intensity of coloration in shell substance.

Ligament opisthodontic, consisting of extremely short, external yellowish periostracal element in indistinct lanceolate escutcheon; internal ligamental element or resilium, rather strong and placed in moderately elongate chondrophore.

Hinge teeth consisting of both cardinal and lateral ele-

ments. In right valve, dentition stronger, cardinal complex consisting of small, subdeltoid anterior and posterior teeth; right anterior lateral tooth subproximal to cardinal complex, rather well developed, bluntly pointed, upcurled, and socketed above; right posterior lateral tooth distal, behind external ligament and resilium, bluntly pointed and socketed above. In left valve, cardinal complex consisting of narrow, protuberant, anterior tooth and tiny, thin, obsolete or absent posterior tooth closely juxtaposed to ventral surface of internal resilium. Anterior lateral tooth subproximal to cardinal complex, weak, irregular, blunt protuberance along anterior dorsal margin. Posterior lateral tooth stronger, distal to cardinal complex and behind chondrophore, shelf-like, narrow and bluntly pointed.

Muscle scars not strongly impressed. Anterior adductor muscle scar irregularly elongate-subquadrate; posterior adductor muscle scar rounded. Pallial sinus dissimilar in opposite valves; in right valve, arched, gently arcuate, confluent with pallial line some distance from anterior adductor muscle scar; in left valve, more or less extending straightly anterior from posterior adductor muscle scar, very gently descending to confluence with pallial line some distance from anterior adductor muscle scar.

Shell whitish, usually suffused internally and centrally with yellow, purple or peach coloration; internally usually not highly polished.

Measurements:

Length	Height	Width	H/L	W/L	Remarks
13.5 mm	12.5 mm	7.2 mm	.92	.53	lectotype of <i>petiti</i> Ankilibé (23°25' S; 43°45'
12.8	11.8	7.4	.92	.57	E) Madagascar
10.5	9.2	4.9	.88	.46	Plage de Tuléar Madagascar Ankilibé (23°25' S; 43°45'
10.5	9.1	5.0	.86	.48	E) Madagascar Ankilibé (23°25' S; 43°45'
8.9	7.8	4.1	.87	.46	E) Madagascar
6.1	5.4		.88		Pointe à Larrée, Madagascar

Types. Dautzenberg (1923) in his description of *Iacra petiti* gave a measurement of a specimen (height, 14 mm; length, 15 mm; diameter, 8 mm) and provided a figure.

In the original material at the Brussels Museum, no type-specimen was designated. Nor, for that matter, was a type-locality assigned since the original description listed Tamatave, Foulpointe, Tuléar, and plage d'Ankilibé, Madagascar. In 1929 Dautzenberg provided several further localities from the island. I herein select a lectotype measuring $13.5 \times 12.5 \times 7.2$ mm, from the beach at Ankilibé, which is therefore restricted and designated as the type-locality.

Remarks. Dautzenberg (1923) described this species based on a series of specimens from Madagascar; most of the material listed in the section of *Specimens examined* is in the Brussels Museum, was available to him, and consists mostly of beach worn specimens. However, one lot from Ankilibé, near Tuléar on the southwestern portion of Madagascar included specimens which were obviously living when collected. From them, as noted previously, a lectotype has been selected.

In contrast to *trotteriana*, *petiti* can be recognized by its relatively strongly developed resilium while in comparison to *seychellarum* to which *petiti* is more closely allied, it may be distinguished by its plump, rounded shape (the mean W/L ratio is 50), rather heavier shell and thicker dental elements, tendency to yellowish-purplish central suffusions, and left pallial sinus which is well separated from the anterior adductor muscle scar. Additionally, the acentric scissulate sculpture on the central disc as well as the concentric, incised lirations along the anterior slope are more widely spaced in *petiti* (about 2-4/mm).

The shells of *petiti* show certain ontogenetic changes. Small individuals from Ranofotsy (4.5×3.7 mm) were thin and translucent, especially centrally; umbos were, as might be expected, more easily discernable, slightly opisthogyrous and sharply pointed. The internal surface of younger specimens also had more noticeable shining, highly polished internal surfaces. Many individuals had fallen prey to muricids which had bored holes through the shells, especially in the umbonal region.

In establishing *petiti*, Dautzenberg (1923) discussed the status of *Iacra*, according to its generic rank, and noting that

Strigillina Dunker was synonymous; he pointed out its similarity to the tellinid *Strigilla* but noted that its familial affinities were, because of the internal ligamental resilium, with the Scrobiculariidae (= Semelidae). According to his locality data, several of the samples were taken as living specimens (exemplaires vivants) - namely at Tamatave, Foulpointe and Ankilibé. The preferred bottom type was muddy sand. He subsequently added (1929; 1932) several localities where specimens were obtained by his correspondents on the island; these data are incorporated herein. The species has not been cited subsequently, at least by its own name! The material listed by Barnard (1964: 535) as *Iacra trotteriana* from the Tongaat River and from Durban, Natal proved upon examination to be *petiti* while the sample from Ilha dos Portuguesos, Inhaca [island], Mozambique listed as *trotteriana* and figured by Boshoff (1965: 157, pl. IX, fig. 1) is also *petiti*—though the original material could not be obtained from Mozambique for study.

Zoogeographically, *petiti* has a rather limited distribution along the eastern and southwestern shores of Madagascar and the relatively adjacent peripherally subtropical areas of Natal, South Africa and Mozambique (Map 2). Although a few dead, beach worn specimens of *seychellarum* have been taken in samples with *petiti*, it is more probable that the species are allopatric; the ranges may overlap in Mozambique along that portion of the African coast but the known sample from that area, Inhaca by Boshoff (1965), is based on a dead specimen. With their stronger right lateral dentition, the rather robust shells of *petiti* contrast markedly with the more fragile, probably sympatric *trotteriana*.

Specimens examined (Map 2). REPUBLIC OF SOUTH AFRICA: Tongaat River (29°34' S; 31°11' E); Durban, Natal (both SAM). MADAGASCAR: plage de Tuléar; plage de Ankilibé (23°25' S; 43°45' E); Andrahomana, S of Fort Dauphin; baie du Ranofotsy, SW of Fort Dauphin; baie du Galions, W of Fort Dauphin; Anse Dauphine, Fort Dauphin; plage de Vatomandry (19°20' S; 48°59' E); plage d'Andevoranto, N of Vatomandry (18°40' S; 48°35' E); Ambila, S of Tamatave; plage de Soanierana, N of Tamatave

(18°56' S; 47°31' S; 47°31' E; Pointe à Larrée, opposite Ile. Ste. Marie (16°50' S; 49°50' E) (all IRSNB).

***Abra (Iacra) trotteriana* (Sowerby)**

Plate 22, figs. 5–8; Plate 25, figs. 1–3; Map 2

Strigillia (sic) trotteriana Sowerby 1894. Jour. of Conch. 7: 376 (holotype, BMNH; type-locality, Durban, South Africa); 1897. Appendix to Marine Shells of South Africa, p. 23, pl. 6, fig. 32 (incorrectly refers to Jour. of Conch., vol. vii, p. 12, April, 1896).

Iacra trotteriana (Sowerby). Barnard. 1964, Ann. South African Mus. 47 (3): 535.

Description. Shell extending to about 20 mm in length and to about 18 mm in height, ovate-subtrigonal, inequilateral subequivalve, with left valve slightly more inflated and convex, subfragile to solid, not too strongly compressed with very weak posterior flexure to right. Umbos somewhat anterior to middle, pointed, almost orthogyrous, not greatly inflated, rather flattened, with left umbo a little lower than the right. Anterior margin convex (more broadly rounded in larger specimens); ventral margin gently convex; anterior dorsal margin short, rather gently inclined, making rather abrupt confluence with anterior (especially in younger individuals); posterior dorsal margin longer, rather steeply inclined, and more or less straight; posterior margin short, irregularly convex and rounded, forming a rather blunt weakly subtrigonal outline posteriorly.

Ligament opisthodontic, short, consisting of yellowish-brown periostracal element set in indistinct escutcheon and of a rather strong elongate subtrigonal calcareous portion subtended by flattened nymphs. Internal ligamental element or resilium markedly reduced, very small, and set in a tiny, very shallow, slit-like obsolete chondrophore.

Hinge teeth consisting of both cardinal and lateral elements. In right valve, dentition stronger with cardinal complex consisting of angular, narrow shelf-like anterior tooth and perpendicular, narrowly subdeltoid posterior tooth; anterior lateral tooth subproximal to cardinal complex, rather well developed, weakly upcurled, blunt, shelf-like and socketed above; posterior lateral tooth distal to

cardinal complex and behind ligamental apparatus, pointed, shelf-like, and socketed above. In left valve, cardinal complex consisting of narrow, slightly thickened, nearly perpendicular, anterior tooth and very thin, fragile, obsolete and frequently broken posterior tooth which lies along the base of the tiny chondrophore; anterior lateral tooth consisting of subproximal irregular shelf-like tuberosity; posterior lateral tooth distal, very small, poorly developed and pointed.

Sculpture variable, consisting of several moieties: along anterior slope, finely incised concentric lirations (6–12/mm) and more crowded along the periphery and dorsal slope; acentric, posteriorly and steeply descending scissulations on central disc, generally 4–6/mm; and, very closely spaced, more or less concentric, finely incised lirations along the dorsal slope (7–12 mm). Strongly raised, sharply differentiated, coarse (1/mm) concentric ridges or riblets may develop over the disc, especially peripherally and in the right valve (Plate 25, fig. 2). Further, fine concentric lirations may be formed especially on the central disc, and more noticeably in the left valve, presenting an irregularly reticulate pattern with the acentric scissulations (Plate 25, fig. 1). Posterior radial ridge not strongly developed but more noticeable in larger (19 mm) individuals. Irregular growth annulae, up to 8, sometimes discernable by differential coloration or translucence of shell substance.

Muscle scars rather poorly impressed. Anterior adductor muscle scar irregularly subquadrate (evidently dorsal portion actually being anterior pedal retractor muscle scar). Posterior adductor muscle scar rounded to irregularly subtrigonal. Pallial sinus dissimilar in opposite valves; in right valve, extending for short distance straight anteriorly and then dropping sharply to become confluent with posterior half of pallial line; in left valve, pallial sinus extending somewhat upward anteriorly at first and then very gently becoming confluent with anterior adductor muscle scar (occasionally in younger individuals, pallial sinus not connected to anterior adductor muscle scar but confluent with pallial line just below the anterior adductor muscle).

Shell predominately white, rarely suffused centrally with

yellowish or purplish coloration. Internally not highly polished.

Measurements:

Length	Height	Width	Remarks
12.0 mm	10.0 mm	mm	holotype of <i>trotteriana</i>
19.9	18.1	9.6	Koseir, Red Sea
18.5	16.2	9.2	El Tor, Bay of Suez
16.9	14.6	7.8	Djibouti, Gulf of Tadjura, Gulf of Aden
14.6	13.2		Natal, South Africa, right valve
13.2	11.7	6.5	Massawa, Eritrea, Ethiopia
12.3	11.2		Ambila, Madagascar, left valve
11.7	10.5	6.2	Massawa, Eritrea, Ethiopia
8.5	7.5		Ambila, Madagascar, right valve

Remarks. The most variable of the species of *Iacra*, *trotteriana* is especially characterized by its very reduced chondrophore. The internal resilial element of the ligament is very much atrophied and consists of an extremely small, slit-like element sandwiched between the posterior cardinal tooth and the rather flattened nymphal plate supporting the external opisthodetic ligament (Plate 22, figs. 5-8). Such a reduced internal ligament is paralleled in the Indo-Pacific-Australian semelid *Semelangulus* and, in the case of *trotteriana*, brings the species even closer in appearance to the true tellinid genus *Strigilla*, which totally lacks even a very small chondrophore and its concomitant resilium. The reduction in the size of the resilium and chondrophore serves to distinguish *trotteriana* from both *seychellarum* and *petiti*.

Morphologically, *trotteriana* has a variable sculpture which in its most simple form is dominated by the acentric scissulations across the central disc. However, in several samples from the Red Sea and Gulf of Suez, including some which were identified as *seychellarum* by Sturany (1901) in his report on the results of the *Pola* expedition, the shells attain their maximum size and have a much stronger sculpture. The left valve (Plate 25, fig. 1) may appear somewhat reticulate on the disc where the concentric sculpture intersects with the acentric scissulations. The right valve may have strongly raised, coarse concentric ridges (Plate 25, fig. 2) similar in their form to those found

in *Semele modesta* (Reeve) of the South Atlantic (Boss, 1972),

Subsequent to the original description and remarks of Sowerby (1894: 376; 1897: 23), this species was not cited again until Barnard (1964: 535) listed it in *Iacra*, a citation which I think might well have been for another species (see *Remarks* under *petiti*) though *trotteriana* does occur, at least as partial specimens, in South Africa. Boshoff (1965: 183, pl. IX, fig. 2), following Barnard, also confused these species, figuring a specimen, which is no longer available for study since the revolution in Portuguese East Africa, of *trotteriana* as "*seychellarum*" from Punta Torres, Inhaca Island, Mozambique.

In shape, *trotteriana* tends to be somewhat subquadrate in smaller individuals and more ovate-subtrigonal in adults. In the right valve, the posterior dorsal slope and its conjoining with the umbonal region evince a "hunched" or arched contour, which is sometimes helpful in recognizing beach worn valves.

The distribution of living *trotteriana* is really poorly known since most of the samples listed in the section on *Specimens examined* are based on miscellaneous beach worn valves. The species occurs in the Red Sea, probably along the coast of east Africa to Natal, South Africa, and possibly in such offshore islands as Madagascar. The marked concentric sculpture in the right valve and noticeable reticulations in the left valve seem to occur in populations in the Gulf of Suez and Red Sea areas, and since only poorly preserved material has been obtained from South Africa, Mozambique and Madagascar and no samples whatsoever along the intervening African coast, it is possible that the northern population may be subspecifically or even specifically distinct. However, since so few data are available, it is deemed unwise to establish yet another poorly known "new species" of bivalve.

Specimens examined (Map 2). REPUBLIC OF SOUTH AFRICA: Natal; Tongaat River, Natal; Durban, Natal (all SAM). MADAGASCAR: baie de Ranofotsy, SW of Fort Dauphin; baie de Galions, W of Fort Dauphin; Anse Dauphine, Fort Dauphin; Ambila, S of Tamatave; Tamatave

Veno (all IRSNB); Tamatave (NR); plage de Soanierana, 18°56' S; 47°31' E, N of Tamatave (IRSNB). FRENCH SOMALILAND: Djibouti, Gulf of Tadjura, Gulf of Aden (MNHNP). ETHIOPIA: Massawa, Eritrea, Red Sea (NMW; ZMB). EGYPT: *Pola* Station 21, Koseir, 26°06' N; 34°17' E; *Pola* Station 8, El Tor, 28°14' N; 33°37' E, Sinai Peninsula, Gulf of Suez (both NMW).

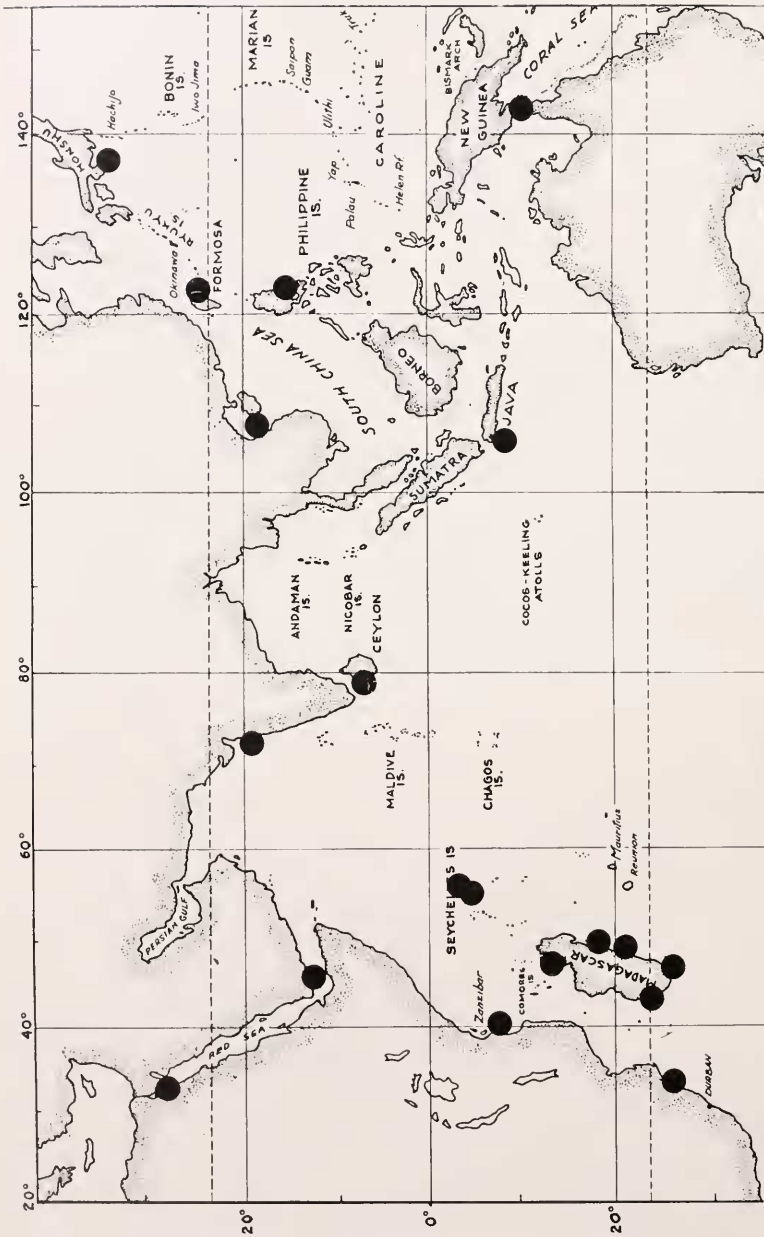
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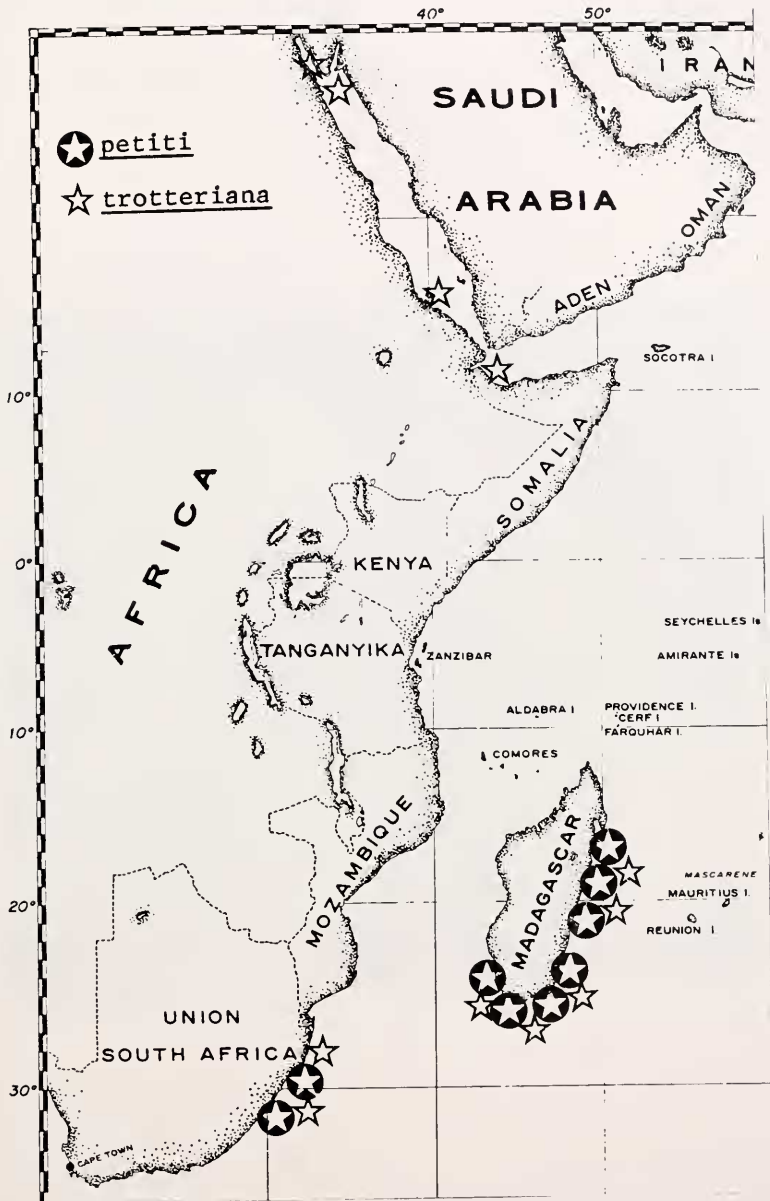
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Maps 1 and 2
Plates 20-25



Map 1

The distribution of *Abra (Iacra) Seychellarum* (A. Adams).



Map 2

The distribution of *Abra (Iacra) petiti* (Dautzenberg) and *A. (I.) trotteriana* (Sowerby).

Plate 20

Abra (Iacra) seychellarum (A. Adams)

- Fig. 1. Holotype of *Syndosmya strigilloides* Vaillant 1865. External view of the left valve (sur la plage du désert de l'Attaka, Baie de Suez, 16.0 × 13.0 × 6.0 mm, MNHNP).
- Fig. 2. External view of the right valve of same.
- Fig. 3. Lectotype of *Scrobicularia seychellarum* A. Adams 1856. External view of the left valve (Seychelles, 21.5 × 17.2 mm, BMNH 78.1.28.197).
- Fig. 4. Enlargement of an external view of the right valve of the neotype of *Strigillina lactea* Dunker 1861, (aus dem Rothen Meere, 14.2 × 12.0 × 6.3 mm, MCZ 288004).

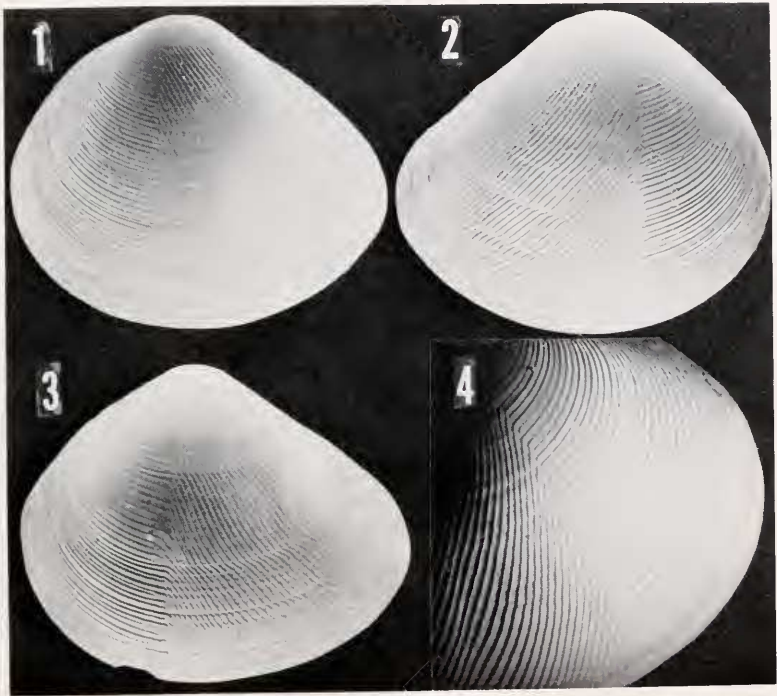


Plate 20

Plate 21

Abra (Iacra) seychellarum (A. Adams)

- Fig. 1. Neotype of *Strigillina lactea* Dunker 1861. External view of the left valve (aus dem Rothen Meere, $14.2 \times 12.0 \times 6.3$ mm, MCZ 288004).
- Fig. 2. External view of the right valve of same.
- Fig. 3. External view of the right valve of *A. seychellarum* (from Nosy Iranja, about 30 miles SW of Nosy Bé, Madagascar, $12.1 \times 9.2 \times 4.9$ mm, MCZ 288378).

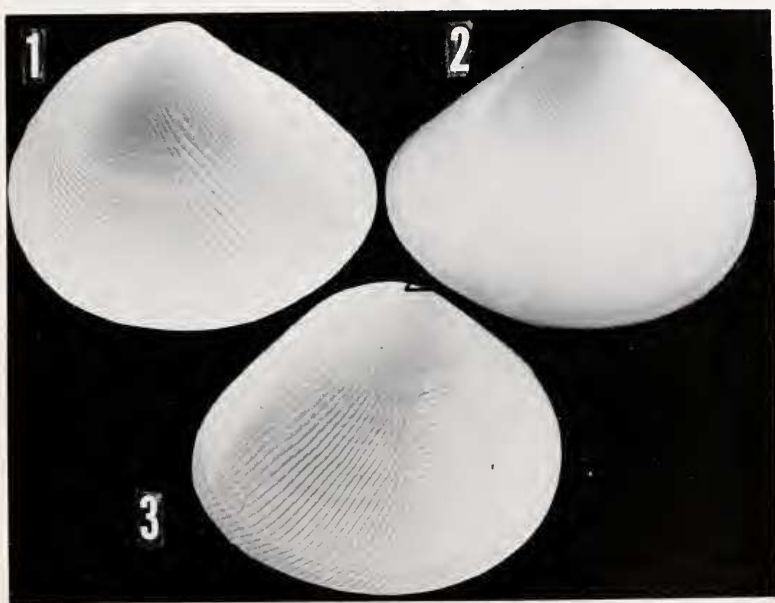


Plate 21

Plate 22

Hinge lines, dentition, and position of the resilium in *Iacra*

Figs. 1-4. *Abra (Iacra) seychellarum* (A. Adams)

- Fig. 1. View of the right valve of holotype of *Syndosmya strigilloides* Vaillant 1865 (sur la plage du désert de l'Attaka, Baie de Suez, 16.0 × 13.0 × 6.0 mm, MNHNP).
- Fig. 2. View of a right valve from Nosy Iranja, about 30 miles SW of Nosy Bé, Madagascar, 12.1 × 9.2 × 4.9 mm, MCZ 288378.
- Fig. 3. View of the left valve of the lectotype of *Scrobicularia seychellarum* A. Adams 1856. (Seychelles, 21.5 × 17.2 mm, BMNH 78.1.28.197).
- Fig. 4. View of the left valve of the holotype of *Syndosmya strigilloides* Vaillant 1865 (sur la plage du désert de l'Attaka, Baie de Suez, 16.0 × 13.0 × 6.0 mm, MNHNP).

Figs. 5-8. *A. (I.) trotteriana* (Sowerby)

- Figs. 5 and 6. View of a right valve from Massawa, Eritrea, Ethiopia [Red Sea], 11.7 × 10.5 × 6.2 mm, ZMB 27365.
- Fig. 6. View of a right valve from Koseir, Red Sea, 19.9 × 18.1 × 9.6 mm, NMW.
- Fig. 7. View of a left valve from Massawa, Eritrea, Ethiopia [Red Sea], 11.7 × 10.5 × 6.2 mm, ZMB 27365.
- Fig. 8. View of a left valve from Durban, South Africa, BMNH.

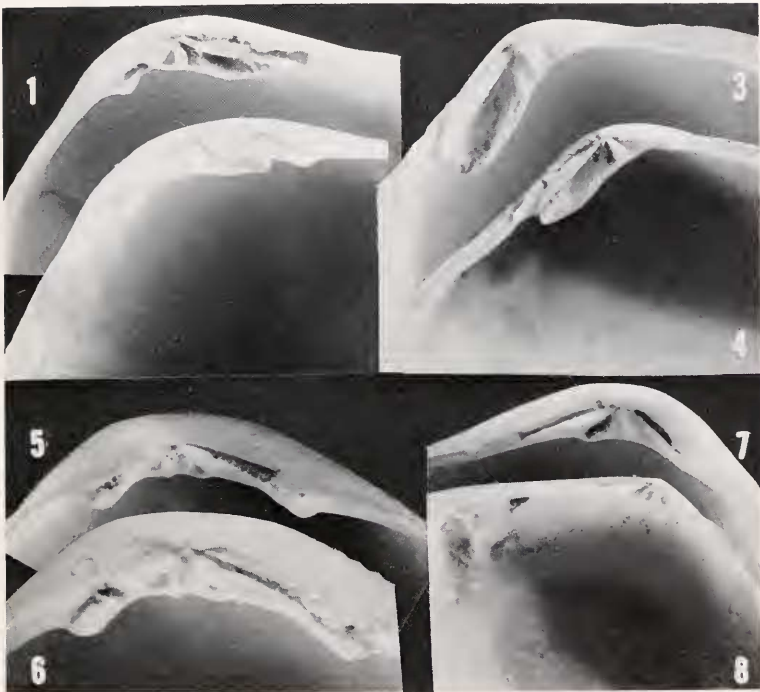


Plate 22

Plate 23

Abra (Iacra) seychellarum (A. Adams). External views of the left valves of specimens from two widely separated localities to show the variation in sculpture, outline of the valves, and comparative strength and configuration of the chondrophore as well as cardinal and lateral dentitions.

Fig. 1. Specimen from Nosy Iranja, about 30 miles SW of Nosy Bé, Madagascar, measuring $12.1 \times 9.2 \times 4.9$ mm, MCZ 288378.

Fig. 2. Specimen from Pelaboean Ratoe ($7^{\circ}05'S$; $106^{\circ}27'E$), Java, Indonesia, measuring 6.2×5.2 mm, USNM 261458.

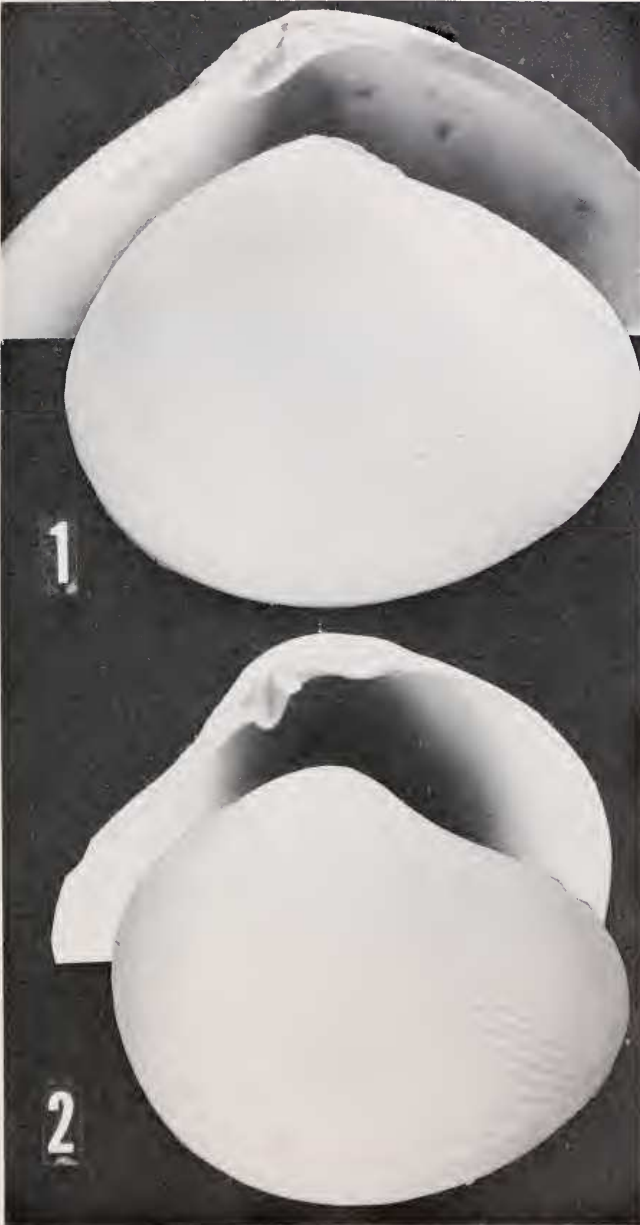


Plate 23

Plate 24

Abra (Iacra) petiti (Dautzenberg)

The lectotype of *Iacra petiti* Dautzenberg 1923, 13.5 × 12.5 × 7.2 mm from plage d'Ankilibé (23°25'S; 43°45'E), Madagascar, IRSNB.

- Fig. 1. External view of the left valve.
- Fig. 2. External view of the right valve.
- Fig. 3. Hinge of the right valve.
- Fig. 4. Hinge of the left valve.

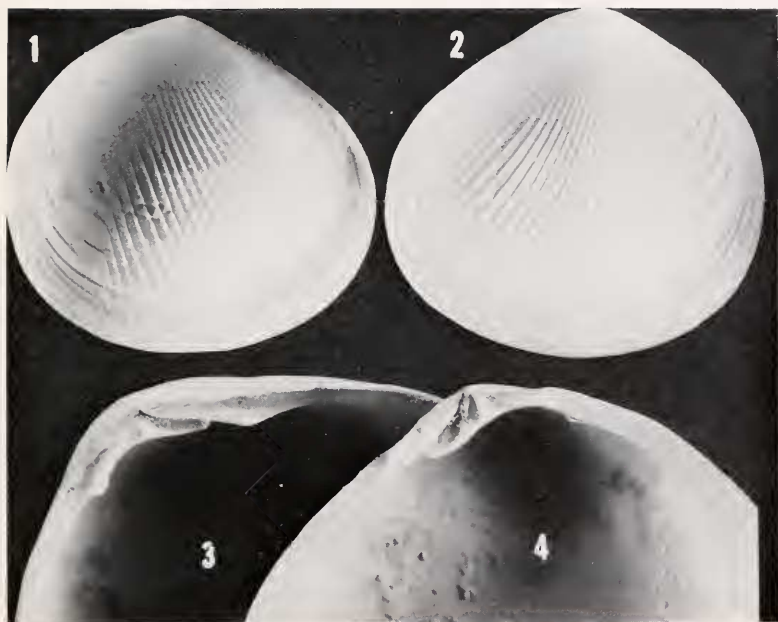


Plate 24

Plate 25

Abra (Iacra) trotteriana (Sowerby)

Specimen measuring $11.7 \times 10.5 \times 6.2$ mm from Massawa, Eritrea, Ethiopia on the Red Sea (in ZMB 27365, collected by Jickeli).

- Fig. 1. External view of the left valve indicating the finely reticulate sculpture occurring in some populations.
- Fig. 2. External view of the right valve illustrating the heavy concentric sculpture of some populations.
- Fig. 3. The holotype of *Strigillia* [*sic*] *trotteriana* Sowerby 1894 (12.0×10 mm, right valve only, from Durban, South Africa [BMNH]).

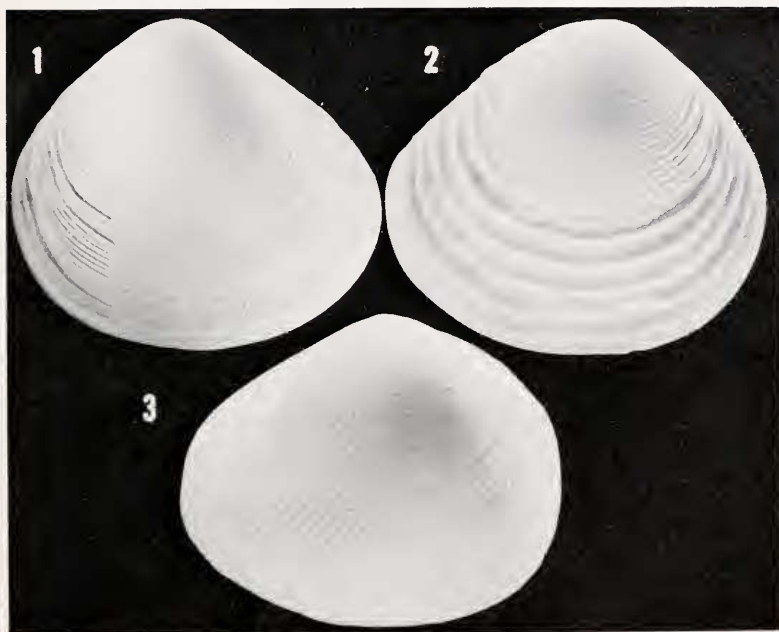


Plate 25